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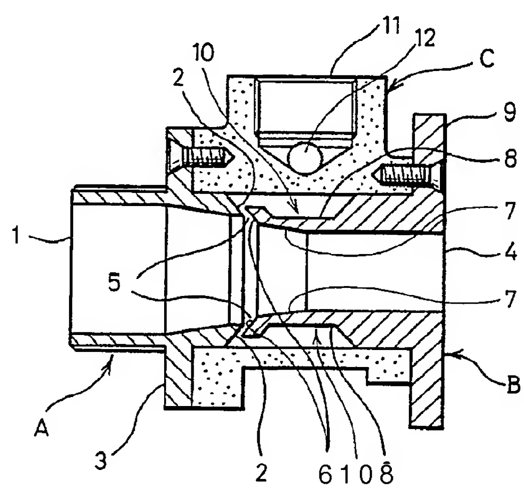
(54) **Coanda spiral flow device.**

(57) A coanda spiral flow device comprising: a first unit (A) having an end introducing port (1), an erect or inclined outer circumferential surface (2) on the end opposite to said port, and a coupling flange (3); a second unit (B) having a discharge outlet (4), an inclined or curved inner circumferential surface (6) on the end oposite to said outlet and having a bore larger than that of said outlet, said inclined or curved surface opposing the said erect of inclined surface on the outer circumference end of said first unit to form a coanda slit (5), a conically tapered inclined surface (7) extending from said inclined or curved surface (6) towards the said discharge outlet, an annular groove (8) on the outer surface adjacent the end having the said inner circumferential surface, and a coupling flange (9); and a removable outer peripheral tube unit (C) having a ventilation portion (11), which covers the said erect or inclined surface of the said first unit and the annular groove on the surface of the said second unit, and having both ends in close contact with the coupling flanges of said first and second units and forming a ventilation distribution chamber (10) which communicates with said ventilation portion.

Fig. 2



EP 0 456 931 A1

The present invention relates generally to a coanda spiral flow device. More specifically, it relates to a coanda spiral flow device which is useful as a flow system unit in the operations of material transportation, drying, and reaction processing, as well as gas supply, mixing and separation, and which is easy to produce and maintain.

Previously, a number of proposals have been made by the inventors of the present invention for the generation of a spiral flow and its application which permits the high-speed conveyance of gases, powdered materials, fibers, cables or other materials and involves a flow system reaction entirely different from the conventional concepts of turbulent flow or laminar flow. The unique phenomenon, a long-distance spiral flow, which makes use of the coanda effect as a fluid phenomenon and which has not been conceived by the conventional application of the coanda effect, has been established as a practical process technology.

A coanda spiral flow is characterized by a vast difference in velocity and density between the axial flow of a fluid and the flow around the axial one, and shows steep velocity distribution. For instance, the degree of turbulence indicates 0.09, i.e. less than half of 0.2 indicated for turbulent flow, showing that coanda spiral flow involves immensely different conditions from turbulent flow. In addition, it is formed as a unique spiral flow by the synthesis of axial vector and radial vector.

This coanda spiral flow is a flow which converges on the pipe axis in a pipe, and possesses superior characteristics in that it has a small degree of turbulence and it can prevent hard collisions and contacts with the pipe inner wall due to the automatic vibration of the conveyed object.

A device for the generation of coanda spiral flow is essential for the application of the concept to a process technology. Coanda spiral flow devices of various forms have been provided heretofore; for example, one having two interconnected units is known.

However, it was difficult to construct a coanda spiral flow device having such a unit construction, and it was far from easy to control the coanda slit clearance, to achieve the desired spiral flow, to an accuracy of the order of 0.01mm during an assembly operation. Thus it was virutally impossible to assemble and use a coanda spiral flow unit at a job site at any time.

Consequently, realization of a coanda spiral flow device which can be assembled at an appropriate site, e.g. a plant of a construction site, at any time and which permits easy adjustment of coanda slit clearance, has been strongly desired.

Viewed from one aspect the present invention provides a coanda spiral flow device comprising: a first unit having an end introducing port, an erect or inclined outer circumferential surface on the end opposite to said port, and a coupling flange; a second unit having a discharge outlet, an inclined or curved inner circumferential surface on the end opposite to said outlet and having a bore larger than that of said outlet, said inclined or curved surface opposing the said erect or inclined surface of said first unit to form a coanda slit, a conically tapered inclined surface extending from said inclined or curved surface towards the said discharge outlet, an annular groove on the outer surface adjacent the end having the said inner circumferential surface, and a coupling flange; and a removable outer peripheral tube unit having a ventilation portion, which covers the said erect or inclined surface of the said first unit and the annular groove on the surface of the said second unit, and having both ends in close contact with the coupling flanges of said first and second units and forming a ventilation distribuiton chamber which communicates with said ventilation portion.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Figs. 1 (a), (b) and (c) are a left side elevation view, a plan view and a right side elevation view, respectively, of a coanda spiral flow device according to the present invention;

Figs. 2 and 3 are an X-X sectional view and a Y-Y sectional view of Fig. 1 (b), respectively; and

Fig. 4 is a schematic drawing showing an example of use of the coanda spiral flow device of Figs. 1 to 3.

As illustrated in Figs. 1 (a), (b) and (c) and Fig. 2, a coanda spiral flow device according to the present invention comprises a first unit A, a second unit B and an outer peripheral tube unit C which partially covers the first unit A and the second unit B and couples them together.

The first unit A has a introducing port 1 at one end, an inclined or erect circumferential surface 2 on its outer circumference at the end opposite to the port 1, and a coupling flange 3.

The second unit B has a discharge outlet 4 at one end, an inclined or curved circumferential surface 6 on its inner circumference at the end opposite from the outlet 4, where the bore is larger than that of the outlet 4, the surface 6 forming a coanda slit 5 in conjunction with the surface 2 of the first unit A, a conically tapered surface 7 extending from said surface 6 towards said discharge outlet 4, an annular groove 8 on the outer circumference adjacent the end formed with the surface 6, and a coupling flange 9.

As becomes evident from the above described features of the first unit A and the second unit B, there are no threaded portions oor bolted portions which directly couple together the units A and B in

the coanda spiral flow device of the present embodiment.

Accordingly, it becomes very easy to form the inclined or erect circumferential surface 2 on the outer circumference of unit A, the inclined or curved circumferential surface 6 on the inner circumference of unit B, and the annular groove 8 on unit B, thus permitting the accuracy of the dimensions and the surface smoothness of these parts to be improved remarkably.

The outer peripheral tube unit C is a coupling means to couple the first unit A with the second unit B, while achieving a specified clearance of the coanda slit 5 to high precision. The ends of the unit C closely engage with the coupling flange 3 of the first unit A and the coupling flange 9 of the second unit B, respectively, to link the units A and B together. As shown in Figs. 2 and 3, the outer peripheral tube unit C covers the annual groove 8 in the second unit B to form a ventilation distribution chamber 10 which communicates with a compressed gas inlet port 11 via conduits 12.

The interconnection of the first unit A, the second unit B and the outer peripheral tube unit C can be easily effected by threaded fastenings at the coupling flanges 3 and 9. By adjustment of the threaded fastenings, the clearance of the coanda slit 5 through which compressed gas is fed can be set to a specified gap. The outer peripheral tube unit C is removable from the first and second units A and B. Various kinds of first unit A, second unit B and outer peripheral tube unit C, which are designed in advance to form the specified coanda slit 5, may be envisaged. This eliminates the difficulty which is inherent if the coanda slit 5 is adjusted during assembly as in the case of a conventional coanda spiral unit, and thus permits the occasional assembly of the units at a job site, thereby remarkably improving convenience, and process accuracy and efficiency.

As has been described above, since the outer peripheral tube unit C is provided with the conduit 12, compressed gas can be supplied evenly to the ventilation distribution chamber 10, and the problem of providing constant pressure, which occurs in a conventional unit, can also be overcome.

In the coanda spiral flow device of the present embodiment, a compressor and a gas bomb can be used, as conventionally, to supply compressed gas at a pressure of approximately 2 to 10kg/cm^2, thereby making it possible to convey materials and goods at high speeds. For example, 25 to 30m of optical fibers or other cables can be passed through a tube in a few seconds to minutes, and even approximately 250m cables can be passed. High-speed conveyance, drying and reaction, as well as the classification of metals, ceramics, polymers or other powdered materials can also be performed.

EXAMPLE 1

The coanda spiral flow unit illustrated in Figs. 1 to 3 was manufactured with the bore of the end introducing port 1 being 33mm in diameter, the bore of the outlet 4 21mm in diameter, the bore of the outer peripheral tube unit C 38mm and its length 56mm, and the clearance of the coanda slit 5 0.18mm.

It was easy to manufacture such a unit, and the coanda slit 5 showed an excellent accuracy.

EXAMPLE 2

Using a unit manufactured as in EXAMPLE 1, and referring now to Fig.4, a polyethylene rope was passed through a passage 13 having a total length of 25m consisting of $1_1 = 5$m, $12 = 5$m, $1_3 = 5$m, and $1_4 = 10$m. A 22mm-dia. CD pipe was used as the passage 13, and the diameter of the polyethylene rope was 3mm.

The passage 13 was connected to a flexible hose 15 at a joint box 14, and the foregoing coanda spiral flow unit, indicated at 16, was linked to the flexible hose 15, which was 1.5m long.

The coanda spiral flow unit 16 was provided with an air filter 17, an opening and closing valve 18 and a pressure gauge 19. Compressed air was supplied using a compressor.

Using compressed air with a pressure of 6kg/cm^2, a cable could be passed through the 25m-long passage 13 in as short a time as a few seconds. The passing operation proceeded smoothly. The inclined angle of the tapered wall surface 7 of the second unit B of the coanda spiral flow device was set at 15°, and the angle of inclined surface 6 was set at 60°.

When a similar operation was conducted using a N_2 gas bomb of 150kg/cm^2, it could be performed very smoothly at a pressure of 6kg/cm^2.

Moreover, 2.8mm-dia. optical cable with a connecting terminal was similarly passed through a 22mm-bore and 25m-long passage. A smooth passing operation was achieved in approximately 2 minutes without any damage to the cable.

EXAMPLE 3

Using the coanda spiral flow unit manufactured as in EXAMPLE 1, silica grains with a mean grain size of 2 mm were conveyed. At a compressed air pressure of 3kg/cm^2, the smooth conveyance of the silica grains through a 30m-long passage was realized. Virtually no collision or friction of the silica grains against the inner wall could be recognized. The moisture ratio was reduced to 70% of the

original value after one pass. The drying effect was also good.

Using another coanda spiral flow unit which differed from the one of EXAMPLE 1 in having a 0.24mm coanda slit, favorable conveyance and drying effect were also achieved.

It goes without saying that the present invention is not limited to the examples as described above. Various modifications of such a device are possible depending on the size of the unit, coanda slit clearance, compressed gas pressure, bore, and length of passage.

Claims

1. A coanda spiral flow device comprising: a first unit having an end introducing port, an erect or inclined outer circumferential surface on the end opposite to said port, and a coupling flange; a second unit having a discharge outlet, an inclined or curved inner circumferential surface on the end opposite to said outlet and having a bore larger than that of said outlet, said inclined or curved surface opposing the said erect or inclined surface of said first unit to form a coanda slit, a conically tapered inclined surface extending from said inclined or curved surface towards the said discharge outlet, an annular groove on the outer surface adjacent the end having the said inner circumferential surface, and a coupling flange; and a removable outer peripheral tube unit having a ventilation portion, which covers the said erect or inclined surface of the said first unit and the annular groove on the surface of the said second unit, and having both ends in close contact with the coupling flanges of said first and second units and forming a ventilation distribution chamber which communicates with said ventilation portion.

2. A device as claimed in claim 1, wherein the said outer peripheral tube unit is provided with a conduit that supplies compressed gas evenly.

3. A coanda spiral flow device comprising an inlet unit and an outlet unit which cooperate to define a coanda slit, said inlet and outlet units being interconnected by way of a connecting unit in such manner that the dimension of the coanda slit may be set by adjustment of the connection of said inlet unit and/or said outlet unit to said connecting unit.

Fig. 1c

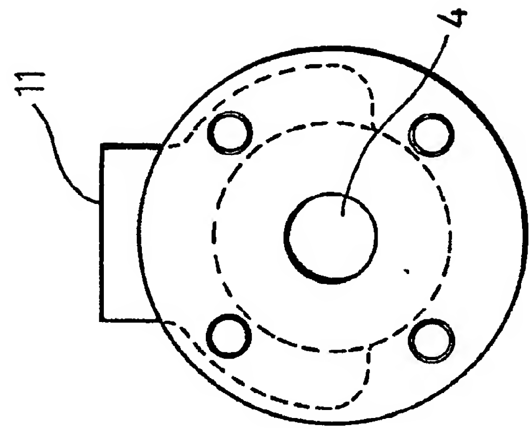


Fig. 1b

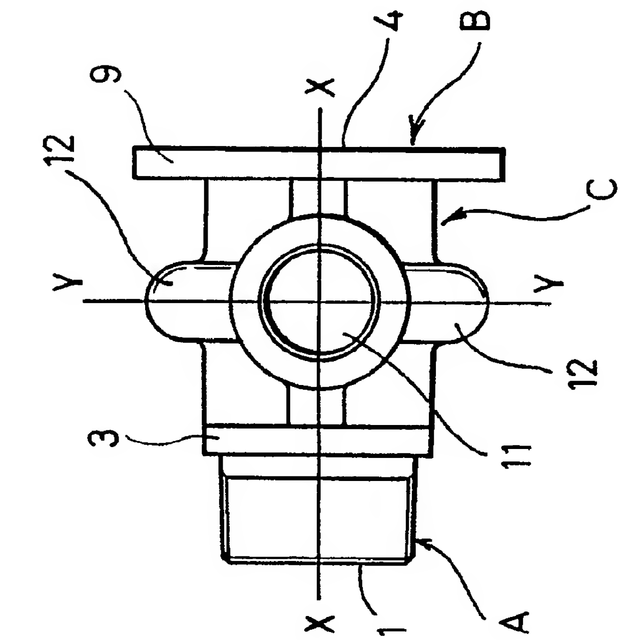


Fig. 1a

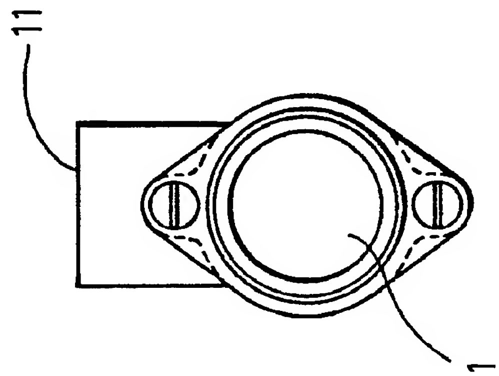


Fig. 3

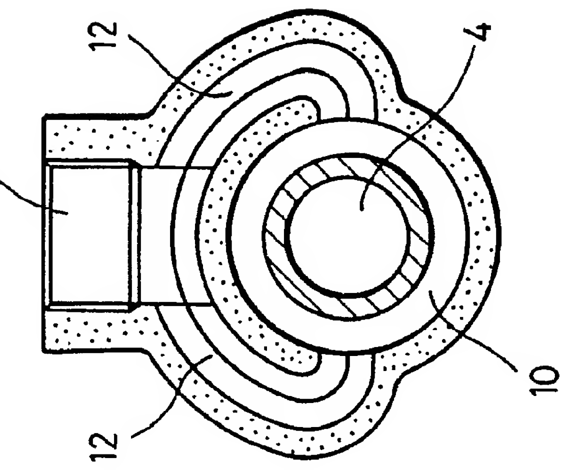
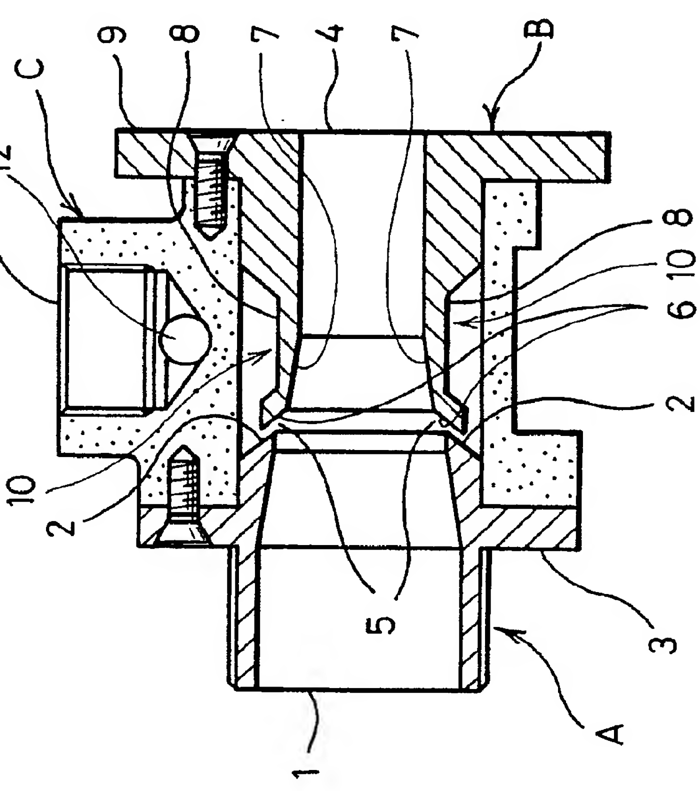


Fig. 2



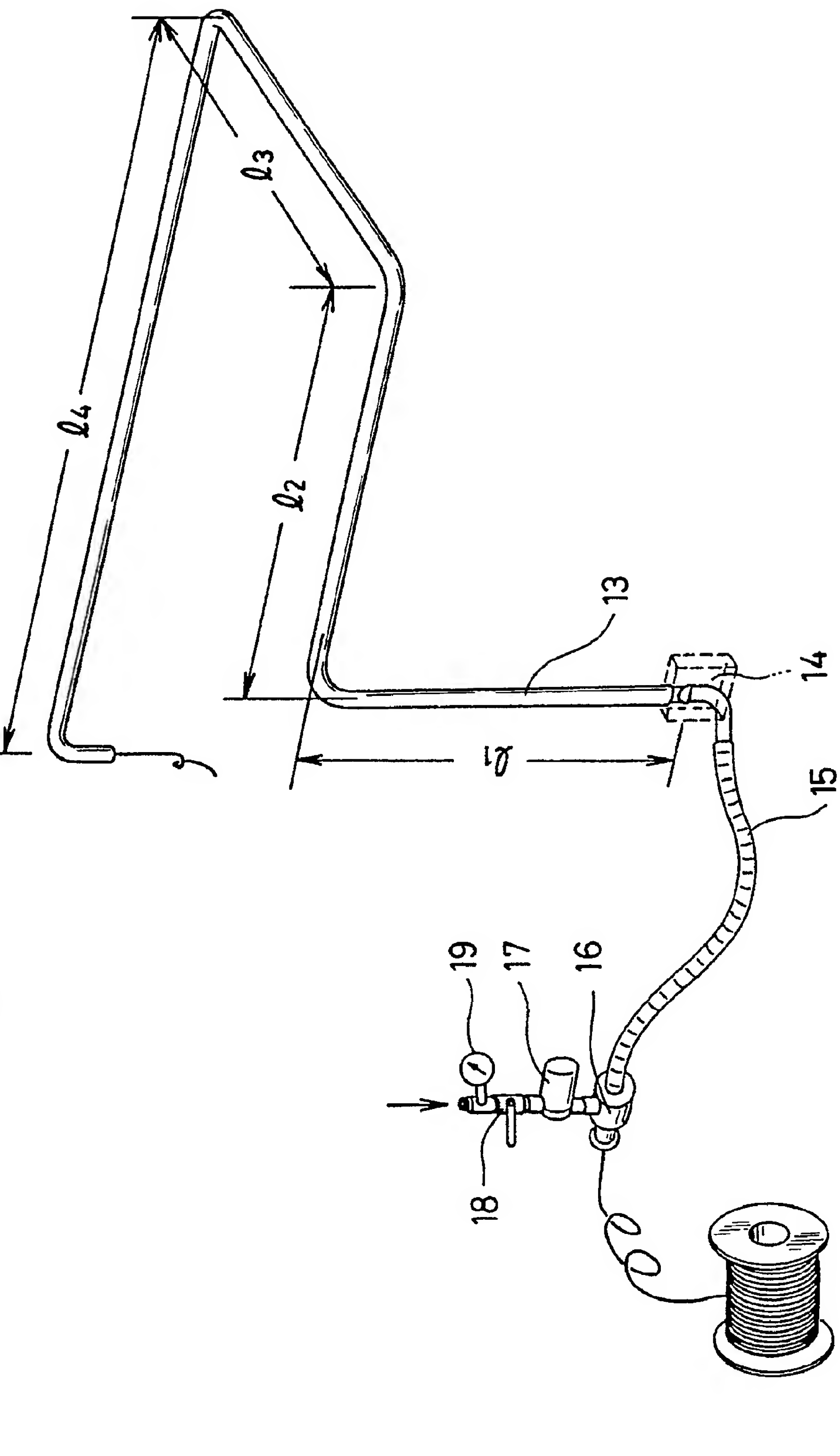


Fig. 4

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EUROPEAN SEARCH REPORT

Application Number

EP 90 30 9894

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-B-1 263 658 (HOLTER) * column 3 - line 11; figure 1 *	1-3	B 65 G 53/58 F 15 D 1/00
P,Y	WO-A-9 008 083 (STENFORS) * the whole document *	1-3	
A	US-A-2 310 265 (SWEENY) *the whole document *	1-3	
A	US-A-1 444 069 (GYGER) * column 2, lines 2 - 69; figure 1 *	1-3	
A	GB-A-994811 (ZIPPEL) * page 2, lines 66 - 103; figures 2, 3 *	1,3	
A	DE-A-1431782 (SCHMIDT)		
A	FR-A-2 637 880 (GOAVEC)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 65 G
F 15 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	15 July 91	FONSECAYFERNANDEZ

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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